

WHAT IS CLAIMED IS:

1. A method for inerting an aircraft fuel tank, said method comprising the steps of:
- (a) contacting compressed air with one or more first membrane modules at conditions effective to produce a first nitrogen-enriched air stream;
- (b) introducing said first nitrogen-enriched air stream into said fuel tank during periods of low demand for nitrogen-enriched air;
- (c) contacting compressed air with one or more second membrane modules at conditions effective to produce a second nitrogen-enriched air stream;
- 10 and
- (d) introducing said second nitrogen-enriched air stream into said fuel tank during periods of high demand for nitrogen-enriched air,
- wherein said first membrane modules have a lower  $O_2$  permeance and a higher  $O_2/N_2$  selectivity than said second membrane modules.
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2. The method according to claim 1, wherein said low demand periods include cruising.
3. The method according to claim 1, wherein said high demand
- 20 periods include ascent or descent or both.

4. The method according to claim 1, further comprising introducing at least one of said first nitrogen-enriched air stream and said second nitrogen-enriched air stream into the fuel in said fuel tank at conditions effective to liberate at least a portion of dissolved O<sub>2</sub> in the fuel.

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5. The method according to claim 4, wherein said first nitrogen-enriched air stream is introduced into the fuel in the fuel tank to liberate at least a portion of dissolved O<sub>2</sub> in the fuel.

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6. The method according to claim 1, wherein said first nitrogen-enriched air stream has a lower flow rate than said second nitrogen-enriched air stream.

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7. The method according to claim 1, wherein said first nitrogen-enriched air stream has a flow rate of 0.05 to 20 lbs/min at 9% by volume O<sub>2</sub> or less, and said second nitrogen-enriched air stream has a flow rate of 5 to 100 lbs/min at 9% by volume O<sub>2</sub> or less.

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8. The method according to claim 7, wherein said first nitrogen-enriched air stream has a flow rate of 0.5 to 2.0 lbs/min at 5% by volume O<sub>2</sub> or less, and said second nitrogen-enriched air stream has a flow rate of 5 to 50 lbs/min at 9% by volume O<sub>2</sub> or less.

9. The method according to claim 1, wherein said first membrane modules have an O<sub>2</sub> permeance of at least 10 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of at least 4.0, and said second membrane modules have an O<sub>2</sub> permeance of at least 100 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of at least 1.5.

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10. The method according to claim 9, wherein said first membrane modules have an O<sub>2</sub> permeance of at least 30 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of at least 5.0, and said second membrane modules have an O<sub>2</sub> permeance of at least 200 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of at least 2.

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11. The method according to claim 1, wherein said compressed air comprises bleed air.

12. The method according to claim 1, wherein said compressed air has a pressure of 10 to 300 psig.

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13. The method according to claim 1, which comprises introducing said first nitrogen-enriched air stream and said second nitrogen-enriched air stream into said fuel tank during periods of high demand for nitrogen-enriched air.

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14. A method for inerting an aircraft fuel tank, said method comprising the steps of:

(a) contacting compressed air with one or more first membrane modules at conditions effective to produce a first nitrogen-enriched air stream;

(b) introducing said first nitrogen-enriched air stream into said fuel tank during cruising;

5 (c) contacting compressed air with one or more second membrane modules at conditions effective to produce a second nitrogen-enriched air stream; and

(d) introducing said second nitrogen-enriched air stream into said fuel tank during ascent or descent or both,

10 wherein said first membrane modules have a lower  $O_2$  permeance and a higher  $O_2/N_2$  selectivity than said second membrane modules.

15 15. The method according to claim 14, further comprising introducing at least one of said first nitrogen-enriched air stream and said second nitrogen-enriched air stream into the fuel in said fuel tank at conditions effective to liberate at least a portion of dissolved  $O_2$  in the fuel.

20 16. The method according to claim 15, wherein said first nitrogen-enriched air stream is introduced into the fuel in the fuel tank to liberate at least a portion of dissolved  $O_2$  in the fuel.

17. The method according to claim 14, wherein said first nitrogen-enriched air stream has a lower flow rate than said second nitrogen-enriched air stream.

5 18. The method according to claim 14, wherein said first nitrogen-enriched air stream has a flow rate of 0.05 to 20 lbs/min at 9% by volume O<sub>2</sub> or less, and said second nitrogen-enriched air stream has a flow rate of 5 to 100 lbs/min at 9% by volume O<sub>2</sub> or less.

10 19. The method according to claim 18, wherein said first nitrogen-enriched air stream has a flow rate of 0.5 to 2.0 lbs/min at 5% by volume O<sub>2</sub> or less, and said second nitrogen-enriched air stream has a flow rate of 5 to 50 lbs/min at 9% by volume O<sub>2</sub> or less.

15 20. The method according to claim 14, wherein said first membrane modules have an O<sub>2</sub> permeance of at least 10 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of at least 4.0, and said second membrane modules have an O<sub>2</sub> permeance of at least 100 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of greater than 1.5.

20 21. The method according to claim 20, wherein said first membrane modules have an O<sub>2</sub> permeance of at least 30 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of at

least 5.0, and said second membrane modules have an O<sub>2</sub> permeance of at least 200 GPU and an O<sub>2</sub>/N<sub>2</sub> selectivity of at least 2.

22. The method according to claim 14, wherein said compressed air  
5 comprises bleed air.

23. The method according to claim 14, wherein said compressed air has  
a pressure of 10 to 300 psig.

10 24. The method according to claim 14, which comprises introducing  
said first nitrogen-enriched air stream and said second nitrogen-enriched air stream  
into said fuel tank during ascent or descent or both.

25. A system for inerting an aircraft fuel tank, said system comprising:  
15 (a) one or more first membrane modules for separating compressed air  
into a first permeate stream comprising oxygen-enriched air and a first retentate  
stream comprising nitrogen-enriched air;  
(b) a first conduit for conveying said first retentate stream into said fuel  
tank during periods of low demand for nitrogen-enriched air;  
20 (c) one or more second membrane modules for separating compressed  
air into a second permeate stream comprising oxygen-enriched air and a second  
retentate stream comprising nitrogen-enriched air; and

(d) a second conduit for conveying said second retentate stream into said fuel tank during periods of high demand for nitrogen-enriched air,

wherein said first membrane modules have a lower  $O_2$  permeance and a higher  $O_2/N_2$  selectivity than said second membrane modules.

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26. The system according to claim 25, further comprising a third conduit for introducing at least one of said first retentate stream and said second retentate stream into the fuel in said fuel tank to liberate at least a portion of dissolved  $O_2$  in the fuel.

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27. The system according to claim 25, wherein said first membrane modules have an  $O_2$  permeance of at least 10 GPU and an  $O_2/N_2$  selectivity of at least 4.0, and said second membrane modules have an  $O_2$  permeance of at least 100 GPU and an  $O_2/N_2$  selectivity of at least 1.5.

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28. The system according to claim 27, wherein said first membrane modules have an  $O_2$  permeance of at least 30 GPU and an  $O_2/N_2$  selectivity of at least 5.0, and said second membrane modules have an  $O_2$  permeance of at least 200 GPU and an  $O_2/N_2$  selectivity of at least 2.

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29. The system according to claim 25, wherein said first membrane modules and said second membrane modules are arranged in a bundle-in-bundle configuration.

5 30. The system according to claim 29, wherein said first conduit and said second conduit have common portions.